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*An American National Standard*  
**IEEE Standard**  
**Definitions of Terms**  
**on Facsimile**

ANSI C16.30-1972 — IEEE Std 168-1956

Approved July 11, 1972 by the American National Standards Institute



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*For  
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IEEE Std 167A-1975  
Facsimile Test Chart

## Pattern Descriptions

The pattern number given in the following description may be identified from Figure 1. This chart is designed for scanning in either direction, horizontally across the page.

IEEE Std 167-1966, Test Procedure for Facsimile was based on previous issues of the IEEE Test Chart.

**Patterns 1 and 2.** 96 lines per inch (3.78 lines per millimeter) consisting of 48 dark and 48 light lines, substantially equal in width. In pattern 1, the black corresponds approximately to step 2 and gray to step 7 of pattern 8. In pattern 2, white represents paper white and gray to approximately step 11. These patterns are intended for generating low-modulation high-frequency signals at both ends of the density scale—useful for testing modulation characteristics at edges of band in a frequency shift system.

**Patterns 3, 4, and 5.** Vertical bar patterns at 10, 50, and 96 lines per inch (0.394, 1.97, and 3.78 lines per millimeter) of substantially equal width—useful for square-wave testing at several keying frequencies.

**Pattern 6.** A continuous density wedge designed so that at equal intervals of distance across the page, the variation in reflectance will be roughly equally perceptible to the eye. Reading left-to-right across the page, the relative reflection density values at the heavy dots are approximately as shown in Table 1. Pattern 6 is useful for cases where intermediate reflection densities are needed between the steps in Patterns 7 and 8.

Table 1  
Pattern 6 Density Values

Dot	1	2	3	4	5	6	7
Density	1.95	1.75	1.23	0.73	0.38	0.14	0.03

**Patterns 7 and 8.** Reversed step tablets of 15 steps with reflection densities corresponding the approximately equal perceptibility modified to provide smaller low density increments. Consistent with conventional practice, paper white is understood to be equal to 0.00 in density (approximately 0.07 on an absolute scale). For patterns 7 and 8 the relative reflection densities are shown in Tables 2 and 3 respectively.

These patterns will assist in appraising gradient and absolute scale. They are useful for checking half-tone characteristics. Reversed sequences are used since the dynamic half-tone characteristics may differ for a rising density or a falling density scale.

**Pattern 9.** National Bureau of Standards (NBS) type repeating tri-bar resolution test pattern. Twelve complete sets of three-line patterns are repeated across the sheet. Alternate groups are of different line spacing. Density values are shown in Table 4. This pattern is useful for checking definition.

**Pattern 10.** Rectangle with 45° diagonal marks at each corner—useful for checking index of cooperation, skew, and paper-feed error.

**Patterns 11 and 17.** White wedge on black background and black wedge on white background, 0.07 in (1.78 mm) to zero—useful for checking single-line definition.

**Pattern 12.** W. and L. E. Gurley type Pestre-cov Star pattern. Outer circle 50, second circle 100, and third circle 200 lines per inch (1.97, 3.94, and 7.87 lines per millimeter).

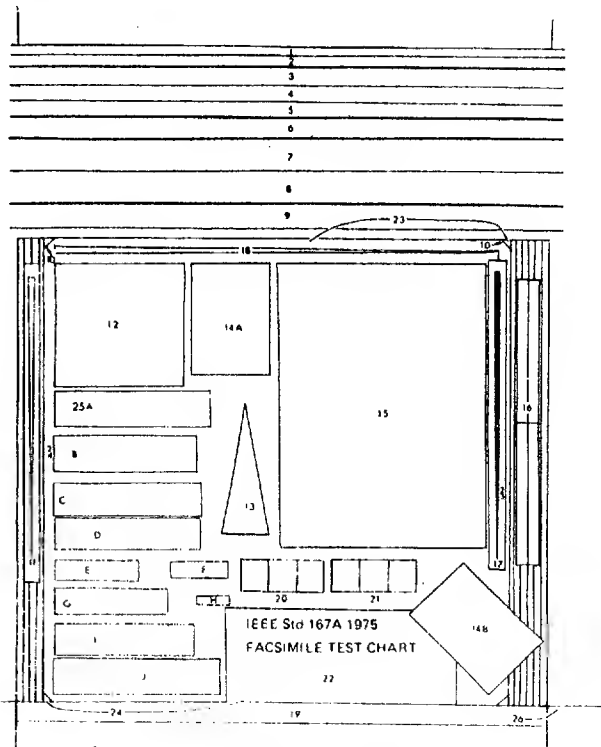


Fig 1  
Pattern Arrangement

**Pattern 13.** Truncated fan-type multiple-line test pattern. Calibrated in lines per inch—useful for checking multiple-line definition along scanning line, envelope delay distortion, and ringing.

**Patterns 14A and 14B.** NBS type Microcopy Resolution test pattern. Numerals indicate the number of cycles (one black plus one white line) per millimeter (that is, line pairs)—useful in checking high definition systems.

**Pattern 15.** Photograph with detail in high-light and shadow. The limiting densities of the photograph approximate those of test patterns 7 and 8.

**Pattern 16.** Vertical gray steps with relative reflection densities of approximately 0.95 and 0.27—useful in testing rising and falling transient characteristics and level variations.

**Pattern 18.** Horizontal "V" pattern with 0.13 in (3.3 mm) opening. Number of scanning line crossings of both lines, multiplied by 7.7 will equal number of lines per inch (multiply by 0.3 for number of lines per millimeter).

**Pattern 19.** "Fence" pattern with 0.01 in (0.254 mm) lines 0.10 in (2.54 mm) apart—useful for checking jitter and measuring available line length.

**Patterns 20 and 21.** Halftone dot screens. Reproduced in approximately 10, 50 and 90 percent black, left to right and at 65 dots per inch (2.56 dots per millimeter) at a 45° angle for pattern 20, and 120 dots per inch (4.72 dots per millimeter) for pattern 21.

**Pattern 22.** Title and credit box. Three sizes of Times Roman type font.

**Patterns 23 and 24.** Fiducial dots forming a 3, 4, 5 right triangle—useful for indicating the presence of skew by comparing the hypotenuse of the two patterns.

**Pattern 25.** Type faces as indicated—useful for checking readability.

**Pattern 26.** Extension lines to permit measurement of available line and useful length of copy.

Table 2  
Pattern 7 Density Test\*

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Density	0.01	0.03	0.08	0.16	0.26	0.36	0.46	0.60	0.72	0.89	1.07	1.22	1.43	1.64	1.80

Table 3  
Pattern 8 Density Values\*

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Density	1.67	1.51	1.32	1.14	0.98	0.85	0.70	0.59	0.48	0.38	0.28	0.18	0.09	0.04	0.02

\*Preliminary values for first batch of test charts.

Table 4  
Pattern 9 Density Values

	Group A						Group B					
	1	2	3	4	5	6	1	2	3	4	5	6
Lines per Inch	61.0	86.4	122	173	244	345	406	284	203	142	102	71.1
Lines per Millimeter	2.40	3.40	4.80	6.81	9.60	13.6	16.0	11.2	7.99	5.59	4.02	2.80

NOTE: Group A lines start at the left. Group B lines start at the right.

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# ***IEEE Standard*** **Definitions of Terms** **on Facsimile**

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**AM to FS Converter.** See *Transmitting Converter, Facsimile*.

**Available Line.** The portion of the scanning line which can be used specifically for *Picture Signals*.

**Bandwidth, Facsimile.** In a given *Facsimile System*, the difference in cycles per second between the highest and the lowest frequency components required for adequate transmission of the *Facsimile Signals*.

**Baseband.** In a carrier (or *Subcarrier*) wire or radio transmission system, the band of frequencies occupied by the signal before it modulates the carrier (or *Subcarrier*) frequency to form the transmitted line or radio signal.

*Note:* The signal in the *Baseband* is usually distinguished from the line or radio signal by ranging over distinctly lower frequencies, which at the lower end relatively approach or may include dc (zero frequency). In the case of a *Facsimile Signal* before modulation on a *Subcarrier*, the *Baseband* includes dc.

**Black Recording.** In an amplitude-modulation system, that form of *Recording* in which the maximum received power corresponds to the maximum *Density* of the *Record Medium*. In a frequency-modulation system, that form of *Recording* in which the lowest received frequency corresponds to the maximum *Density* of the *Record Medium*.

**Black Signal.** The signal at any point in a *Facsimile System* produced by the *Scanning* of a maximum *Density* area of the *Subject Copy*.

**Black Transmission.** In an amplitude-modulation system, that form of transmission in which the maximum transmitted power corresponds to the maximum *Density* of the *Subject Copy*. In a frequency-modulation system, that form of transmission in which the lowest transmitted frequency corresponds to the maximum *Density* of the *Subject Copy*.

**Carbon Pressure Recording.** That type of *Electromechanical Recording* in which a pressure device acts upon carbon paper to register upon the *Record Sheet*.

**Carrier Beat.** The undesirable heterodyne of signals each synchronous with a different stable reference oscillator causing a pattern in received copy. Where one or more of the oscillators is fork controlled, this is called *Fork Beat*.

**Converter, Facsimile.** A device which changes the type of modulation.

**Definition.** Distinctness or clarity of detail or outline in a *Record Sheet*, or other reproduction.

**Delay Distortion.** See *Envelope Delay Distortion*.

**Delay Equalizer.** A corrective network which is designed to make the *Phase Delay* or *Envelope Delay* of a circuit or system substantially constant over a desired frequency range.

**Density (in Facsimile).** A measure of the light-transmitting or -reflecting properties of an area. It is expressed by the common logarithm of the ratio of incident to transmitted or reflected light flux.

*Note:* There are many types of *Density* which will usually have different numerical values for a given material; e.g., Diffuse Density, Double Diffuse Density, Specular Density. The relevant type of density depends

upon the geometry of the optical system in which the material is used.

**Direct Recording.** That type of *Recording* in which a visible record is produced, without subsequent processing, in response to the received signals.

**Drive Pattern.** *Density* variation caused by periodic errors in the position of the *Recording Spot*. When caused by gears this is called *Gear Pattern*.

**Drum Speed.** The angular speed of the transmitter or recorder drum.

*Note:* This speed is measured in revolutions per minute.

**Dual Modulation.** The process of modulating a common carrier wave or *Subcarrier* by two different types of modulation (e.g., amplitude- and frequency-modulation) each conveying separate information.

**Echo.** A wave which has been reflected at one or more points with sufficient magnitude and time difference to be perceived in some manner as a wave distinct from that of the main transmission.

**Effective Band (in Facsimile).** The frequency band of a *Facsimile Signal* wave equal in width to that between zero frequency and *Maximum Keying Frequency*.

*Note:* The frequency band occupied in the transmission medium will in general be greater than the *Effective Band*.

**Electrochemical Recording.** *Recording* by means of a chemical reaction brought about by the passage of signal-controlled current through the sensitized portion of the *Record Sheet*.

**Electrolytic Recording.** That type of electrochemical recording in which the chemical change is made possible by the presence of an electrolyte.

**Electromechanical Recording.** *Recording* by means of a signal-actuated mechanical device.

**Electronic Line Scanning.** That method of *Scanning* which provides motion of the *Scanning Spot* along the scanning line by electronic means.

**Electronic Raster Scanning.** That method of *Scanning* in which motion of the *Scanning Spot* in both dimensions is accomplished by electronic means.

**Electrostatic Recording.** *Recording* by means of a signal-controlled electrostatic field.

**Electrothermal Recording.** That type of *Recording* which is produced principally by signal-controlled thermal action.

**Elemental Area.** Any segment of a *Scanning Line* of the *Subject Copy* the dimension of which along the line is exactly equal to the *Nominal Line Width*.

*Note:* Elemental area is not necessarily the same as the *Scanning Spot*.

**End-of-Copy Signal.** A signal indicating termination of the transmission of a complete *Subject Copy*.

**Envelope Delay.** The time of propagation, between two points, of the envelope of a wave.

*Note:* The *Envelope Delay* is measured by the slope of the phase shift in cycles plotted against the frequency in cycles per second. If the system distorts the envelope the *Envelope Delay* at a specified frequency is defined with reference to a modulated wave which occupies a frequency bandwidth approaching zero.

**Envelope Delay Distortion.** That form of distortion which occurs when the rate of change of phase shift with frequency of a circuit or system is not constant over the frequency range required for transmission.

*Note:* *Envelope Delay Distortion* is usually expressed as one-half the difference in microseconds between the maximum and minimum *Envelope Delays* existing between the two extremes of frequency defining the channel used.

**Facsimile (in electrical communications).** The process, or the result of the process, by which fixed graphic material including pictures or images is scanned and the information converted into signal waves which are used either locally or remotely to produce in record form a likeness (*Facsimile*) of the *Subject Copy*.

**Facsimile Signal (Picture Signal).** A signal resulting from the *Scanning* process.

**Facsimile-Signal Level.** The maximum *Facsimile Signal* power or voltage (rms or dc) measured at any point in a *Facsimile System*.

*Note:* It may be expressed in decibels with respect to some standard value such as 1 milliwatt.

**Facsimile System.** An integrated assembly of the elements used for *Facsimile*.

**Facsimile Transient.** A damped oscillatory transient occurring in the output of the system as a result of a sudden change in input.

**Facsimile Transmission.** The transmission of *Signal Waves* produced by the *Scanning* of fixed graphic material, including pictures, for reproduction in record form.

**Flood Projection.** The optical method of *Scanning* in which the *Subject Copy* is flood-lighted and the *Scanning Spot* is defined in the path of the reflected or transmitted light.

**Fork Beat.** See *Carrier Beat*.

**Frame (in Facsimile).** A rectangular area, the width of which is the *Available Line* and the length of which is determined by the service requirements.

**Framing.** The adjustment of the picture to a desired position in the direction of line progression.

**Framing Signal.** A signal used for adjustment of the picture to a desired position in the direction of line progression.

**FS to AM Converter.** See *Receiving Converter, Facsimile*.

**Gear Pattern.** See *Drive Pattern*.

**Grouping.** Periodic error in the spacing of *Recorded Lines*.

**Halftone Characteristic.** A relation between the *Density* of the recorded copy and the *Density* of the *Subject Copy*.

*Note:* The term may also be used to relate the amplitude of the *Facsimile Signal* to the *Density* of the *Subject Copy* or the record copy when only a portion of the system is under consideration. In a frequency-modulation system an appropriate parameter is to be used instead of the amplitude.

**Index of Cooperation, Scanning or Recording Line.** In rectilinear *Scanning* or *Recording*, the product of the total length of a scanning or recording line by the number of scanning or recording lines per unit length.

*Note 1:* The International Index of Cooperation (diametral index of cooperation) is based on drum diameter and is defined by the International Radio Consultative Committee (CCIR). It is  $1/\pi$  times the *Scanning Line Index of Cooperation*.

*Note 2:* For a scanner and recorder to be compatible the *Indices of Cooperation* must be the same.

**Ink Vapor Recording.** That type of *Recording* in which vaporized ink particles are directly deposited upon the *Record Sheet*.

**Jitter (in Facsimile).** Raggedness in the received copy caused by erroneous displacement of *Recorded Spots* in the direction of *Scanning*.

**Kendall Effect.** A spurious pattern or other distortion in a facsimile record caused by unwanted modulation products arising from the transmission of a carrier signal and appearing in the form of a rectified *Baseband* that interferes with the lower sideband of the carrier.

*Note:* This occurs principally when the single sideband width is greater than half the *Facsimile* carrier frequency.

**Light Carrier Injection.** The method of introducing the carrier by periodic variation of the scanner light beam, the average amplitude of which is varied by the *Density* changes of the *Subject Copy*.

**Magnetic Recording.** *Recording* by means of a signal-controlled magnetic field.

**Maximum Keying Frequency (Fundamental Scanning Frequency).** The frequency in cycles per second numerically equal to the *Spot Speed* divided by twice the *Scanning Spot X Dimension*.

**Maximum Modulating Frequency.** The highest *Picture*

**Frequency** required for the *Facsimile* transmission system.

*Note:* The *Maximum Modulating Frequency* and the *Maximum Keying Frequency* are not necessarily equal.

**Multipath.** See *Multipath Transmission*.

**Multipath Transmission (Multipath).** The propagation phenomenon which results in signals reaching the radio receiving antenna by two or more paths.

*Note:* In *Facsimile*, *Multipath* causes *Jitter*.

**Multiple Spot Scanning.** The method in which *Scanning* is carried on simultaneously by two or more *Scanning Spots*, each one analyzing its fraction of the total scanned area of the *Subject Copy*.

**Noise.** Any extraneous electrical disturbance tending to interfere with the normal reception of a transmitted signal.

**Nominal Line Width.** The average separation between centers of adjacent scanning or recording lines.

**Overlap X.** The amount by which the *Recorded Spot X Dimension* exceeds that necessary to form a most nearly constant *Density* line.

*Note:* This effect arises in that type of equipment which responds to a constant *Density* in the *Subject Copy* by a succession of discrete *Recorded Spots*.

**Overlap Y.** The amount by which the *Recorded Spot Y Dimension* exceeds the *Nominal Line Width*.

**Phase Delay.** In the transfer of a single frequency wave from one point to another in a system, the time delay of a part of the wave identifying its phase.

*Note:* The *Phase Delay* is measured by the ratio of the total phase shift in cycles to the frequency in cycles per second.

**Phase Distortion.** See *Phase-Frequency Distortion*.

**Phase-Frequency Distortion.** Distortion due to lack of direct proportionality of phase shift to frequency over the frequency range required for transmission.

*Note 1:* *Delay Distortion* is a special case.

*Note 2:* This definition includes the case of a linear phase-frequency relation with the zero frequency intercept differing from an integral multiple of  $\pi$ .

**Phasing.** The adjustment of picture position along the scanning line.

**Phasing Signal.** A signal used for adjustment of the picture position along the scanning line.

**Photosensitive Recording.** Recording by the exposure of a photo-sensitive surface to a signal-controlled light beam or spot.

**Picture Frequencies.** The frequencies which result solely from *Scanning Subject Copy*.

*Note:* This does not include frequencies which are part of a modulated carrier signal.

**Picture Inversion.** A process which causes reversal of the black and white shades of the *Recorded Copy*.

**Picture Signal.** See *Facsimile Signal*.

**Ready-to-Receive Signal.** A signal sent back to the *Facsimile Transmitter* indicating that a *Facsimile Receiver* is ready to accept the transmission.

**Receiver, Facsimile.** The apparatus employed to translate the signal from the communications channel into a *Facsimile* record of the *Subject Copy*.

**Receiving Converter, Facsimile (FS to AM Converter).** A device which changes the type of modulation from frequency shift to amplitude.

**Record Medium.** The physical medium on which the *Facsimile Recorder* forms an image of the *Subject Copy*.

**Record Sheet.** The medium which is used to produce a visible image of the *Subject Copy* in record form. The *Record Medium* and the *Record Sheet* may be identical.

**Recorded Spot.** The image of the *Recording Spot* on the *Record Sheet*.

**Recorded Spot X Dimension.** The effective *Recorded Spot* dimension measured in the direction of the recorded line.

*Note 1:* By effective dimension is meant the largest center-to-center spacing between *Recorded Spots* which gives minimum peak-to-peak variation of *Density* of the recorded line.

*Note 2:* This term applies to that type of equipment which responds to a constant *Density* in the *Subject Copy* by a succession of discrete *Recorded Spots*.

**Recorded Spot Y Dimension.** The effective *Recorded Spot* dimension measured perpendicularly to the recorded line.

*Note:* By effective dimension is meant the largest center-to-center distance between recorded lines which gives minimum peak-to-peak variation of *Density* across the recorded lines.

**Recorder, Facsimile.** That part of the *Facsimile Receiver* which performs the final conversion of electrical *Picture Signal* to an image of the *Subject Copy* on the *Record Medium*.

**Recording (in Facsimile).** The process of converting the electrical signal to an image on the *Record Medium*.

*Note:* See *Direct Recording*, *Electrochemical Recording*, *Electrolytic Recording*, *Electromechanical Recording*, *Electrostatic Recording*, *Electrothermal Recording*, *Ink Vapor Recording*, *Magnetic Recording*, and *Photosensitive Recording*.

**Recording Spot (in Facsimile).** The image area formed at the *Record Medium* by the *Facsimile Recorder*.

**Reproduction Speed.** The area of copy recorded per unit time.

**Ringling.** See *Facsimile Transient*.

**Scanner.** That part of the *Facsimile Transmitter* which systematically translates the *Densities* of the *Subject Copy* into signal-wave form.

**Scanning (in Facsimile).** The process of analyzing successively the *Densities* of the *Subject Copy* according to the elements of a predetermined pattern.

*Note:* The normal *Scanning* is from left to right and top to bottom of the *Subject Copy* as when reading a page of print. Reverse direction is from right to left and top to bottom of the *Subject Copy*.

**Scanning Line Frequency.** See *Stroke Speed*.

**Scanning Line Length.** The total length of scanning line is equal to the *Spot Speed* divided by the *Scanning Line Frequency*.

*Note:* This is generally greater than the length of the *Available Line*.

**Scanning Spot (in Facsimile).** The area on the *Subject Copy* viewed instantaneously by the pickup system of the *Scanner*.

**Scanning Spot X Dimension.** The effective scanning spot dimension measured in the direction of the scanning line on the *Subject Copy*.

*Note:* The numerical value of this will depend upon the type of system used.

**Scanning Spot Y Dimension.** The effective scanning spot dimension measured perpendicularly to the scanning line on the *Subject Copy*.

*Note:* The numerical value of this will depend upon the type of system used.

**Signal Contrast (in Facsimile).** The ratio expressed in decibels between *White Signal* and *Black Signal*.

**Signal Frequency Shift.** In a frequency shift *Facsimile System*, the numerical difference between the frequencies corresponding to *White Signal* and *Black Signal* at any point in the system.

**Simple Scanning.** Scanning of only one *Scanning Spot* at a time during the *Scanning* process.

**Skew (in Facsimile).** The deviation of the received *Frame* from rectangularity due to asynchronism between *Scanner* and *Recorder*. Skew is expressed numerically as the tangent of the angle of this deviation.

**Spot Projection.** The optical method of *Scanning* or *Recording* in which the *Scanning* or *Recording* spot is defined in the path of the reflected or transmitted light.

**Spot Speed.** The speed of the *Scanning* or *Recording* spot within the *Available Line*.

*Note:* This is generally measured on the *Subject Copy* or on the *Record Sheet*.

**Stagger.** Periodic error in the position of the *Recorded Spot* along the recorded line.

**Start Record Signal.** A signal used for starting the process of converting the electrical signal to an image on the *Record Sheet*.

**Start Signal.** A signal which initiates the transfer of a *Facsimile* equipment condition from standby to active.

**Stop Record Signal.** A signal used for stopping the process of converting the electrical signal to an image on the *Record Sheet*.

**Stop Signal.** A signal which initiates the transfer of a *Facsimile* equipment condition from active to standby.

**Stroke Speed (Scanning or Recording Line Frequency).** The number of times per minute, unless otherwise stated, that a fixed line perpendicular to the direction of *Scanning* is crossed in one direction by a *Scanning* or *Recording Spot*.

*Note:* In most conventional mechanical systems this is equivalent to *Drum Speed*. In systems in which the *Picture Signal* is used while *Scanning* in both directions, the *Stroke Speed* is twice the above figure.

**Subcarrier.** A carrier which is applied as a modulating wave to modulate another carrier.

**Subject Copy.** The material in graphic form which is to be transmitted for *Facsimile* reproduction.

**Synchronizing (in Facsimile).** The maintenance of predetermined speed relations between the *Scanning Spot* and the *Recording Spot* within each scanning line.

**Synchronizing Signal (in Facsimile).** A signal used for maintenance of predetermined speed relations between the *Scanning Spot* and *Recording Spot* within each scanning line.

**Tailing (Hangover).** The excessive prolongation of the decay of the signal.

**Transmitter, Facsimile.** The apparatus employed to translate the *Subject Copy* into signals suitable for delivery to the communication system.

**Transmitting Converter, Facsimile (AM to FS Converter).** A device which changes the type of modulation from amplitude to frequency shift.

**Underlap X.** The amount by which the center-to-center spacing of the *Recorded Spots* exceeds the *Recorded Spot X Dimension*.

*Note:* This effect arises in that type of equipment which responds to a constant *Density* in the *Subject Copy* by a succession of discrete *Recorded Spots*.

**Underlap Y.** The amount by which the *Nominal Line Width* exceeds the *Recorded Spot Y Dimension*.

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**Useful Line.** See *Available Line*.

**Vestigial Sideband.** The transmitted portion of the sideband which has been largely suppressed by a transducer having a gradual cut-off in the neighborhood of the carrier frequency, the other sideband being transmitted without much suppression.

**Vestigial Sideband Transmission.** That method of signal transmission in which one normal sideband and the corresponding *Vestigial Sideband* are utilized.

**White Recording.** In an amplitude-modulation system, that form of *Recording* in which the maximum received power corresponds to the minimum *Density* of the *Record Medium*. In a frequency-modulation system that

form of *Recording* in which the lowest received frequency corresponds to the minimum *Density* of the *Record Medium*.

**White Signal.** The signal at any point in a *Facsimile System* produced by the *Scanning* of a minimum *Density* area of the *Subject Copy*.

**White Transmission.** In an amplitude-modulation system, that form of transmission in which the maximum transmitted power corresponds to the minimum *Density* of the *Subject Copy*. In a frequency-modulation system, that form of transmission in which the lowest transmitted frequency corresponds to the minimum *Density* of the *Subject Copy*.